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ACCURATE QUANTIFICATION OF CHRONIC MITRAL REGURGITATION BY AUTOMATED TRUE 3-D PROXIMAL ISOVELOCITY SURFACE AREA USING REAL-TIME VOLUME COLOR FLOW DOPPLER TRANSTHORACIC ECHOCARDIOGRAPHY: IN VITRO AND CLINICAL VALIDATION

ACC Oral Contributions
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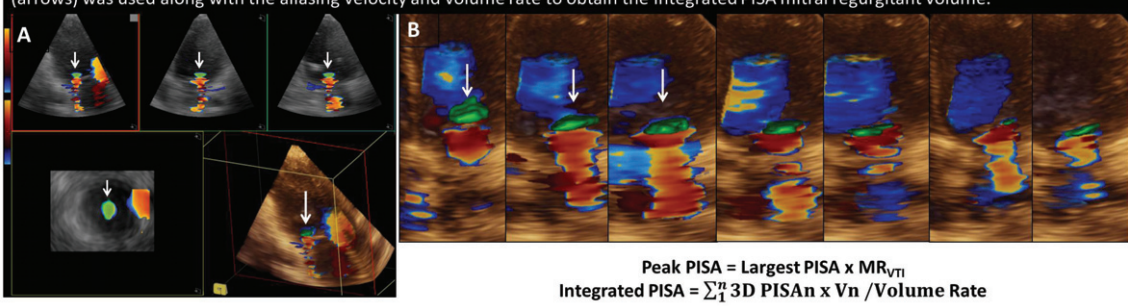
Introduction: We tested the accuracy of automated 3-D PISA quantification of chronic mitral regurgitation (MR) in an in vitro model and patients using real-time volume color flow Doppler (RT-VCFD) TTE.

Methods: In an in vitro model ERO was computed using 2-D hemispheric PISA and by true 3-D PISA automated segmentation (Figure). The regurgitant volume (RVol) was computed using the peak systolic PISA (peak PISA) and a sum of the RVol from each systolic frame (integrated PISA). In patients (N=31, 90% functional MR) same measurements were made with CMR as the reference standard.

Results: In the in vitro study (55 trials) EROA was more underestimated by 2-D than 3-D TTE when compared to true ERO (0.12 ± 0.05cm2, 0.25 ± 0.10cm2, vs 0.35 ± 0.10cm2 p<0.001 for both). The 2-D TTE RVol was underestimated compared to the flowmeter (20 ± 19ml vs. 40 ± 14ml, p<0.001), but both integrated and peak PISA RVol were comparable (38 ± 14ml and 43 ± 16ml vs. 40 ± 14ml, p >0.05 for both). In patients, EROA correlated well with CMR severity of MR r = 0.89 (p<0.001). The integrated PISA RVol was comparable to CMR Rvol (36 ± 21ml vs 37 ± 22ml/beat, p = 0.12), but the peak PISA RVol was higher (46 ± 26ml/beat, p<0.01) perhaps due to the predominance of functional MR. The reproducibility of ERO measurements was excellent (ICC = 0.95).

Conclusion: Automated RT-VCFD PISA technique was more accurate than 2-D TTE for the measurement of EROA and Rvol in an in vitro model of MR. In the clinical setting, automated PISA is feasible and accurate to measure both EROA and RVol in MR.

Figure: (A) Illustration of RT-VCFD volume (bottom right) and four 2-D planes of the PISA with automated segmentation (in green). The peak PISA is illustrated in the volume image and the 2-D planes (arrow). (B) Automatically segmented PISA from each systolic frame (arrows) was used along with the aliasing velocity and volume rate to obtain the integrated PISA mitral regurgitant volume.



Peak PISA = Largest PISA x MR_{VTI}

Integrated PISA = $\sum_1^n$ 3D PISAn x Vn /Volume Rate